EXPANDED PROGRAMME ON IMMUNIZATION

TRAINING COURSE ON PLANNING AND MANAGEMENT

Disease Estimates: Poliomyelitis

WORLD HEALTH ORGANIZATION

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DISEASE ESTIMATES: POLIOMYELITIS

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POLIOMYELITIS

INTRODUCTION

Clinical poliomyelitis is an acute infectious disease of the nervous system, usually occurring as a febrile illness with headaches, a stiff neck, painful muscles, and in many cases, flaccid paralysis with an absence of reflexes but with normal sensation.

Over 70% of the patients who suffer an attack of paralytic poliomyelitis will be left with some degree of this residual flaccid paralysis. These patients will have this disability for life.

Although almost all children living in tropical countries will be infected by all three poliomyelitis viruses before they reach the age of 5 years, only a small fraction, about 1%, will actually develop the paralytic disease. For this reason, it is important to distinguish between infection and disease when discussing the impact of the poliomyelitis problem in a country. The present pattern of poliomyelitis (for example, current age-specific attack rates) may change in the future as immunization programmes reduce the incidence of the disease.

To estimate the importance of poliomyelitis in a country, the following steps should be performed:

1.0 Estimate the prevalence and prevalence rate of poliomyelitis.

2.0 Estimate the annual incidence and incidence rate of poliomyelitis.

3.0 Estimate the age-specific immunity to each type of poliomyelitis virus.

Because mortality from poliomyelitis is relatively low in the context of overall childhood mortality, the estimation of poliomyelitis mortality will not be discussed in this booklet. Case fatality rates for paralytic poliomyelitis generally vary between 10-20%.

This booklet provides detailed guidelines for performing each of the steps listed above. It also includes exercises which require you to perform the steps using data on Fictitia. Fold out pages PO-13 and 15, which contain selected data on poliomyelitis for Fictitia. You will use these data to complete the exercises in this booklet. Do not read through the entire booklet first, but complete the exercises and fill in the data for Fictitia as you go along.

1.0 ESTIMATE THE PREVALENCE AND PREVALENCE RATE OF POLIOMYELITIS.

The prevalence of poliomyelitis is the number of cases of the disease
in a defined population at a specific point in time. Estimates of polio-
myelitis prevalence are most easily obtained through sample surveys of
school enterers, because most of the cases will occur before age 3. It
has been shown that school surveys pick up 50% of the actual cases of
disease. The remaining 50% either do not attend school, have recovered,
or have died from poliomyelitis or some other cause. In regions where
a low proportion of the children attend school, village surveys
should be used to estimate prevalence. Prevalence rates of paralysis
have varied from 1 per 1000 to 20 per 1000.

The process described below can be used to estimate the prevalence and
prevalence rate of poliomyelitis in each region and in the country.

Prevalence Rate Per 100,000 Population in Region:

- Number of school   Number of school   Prevalence rate
  enterers with   enterers in study   of paralytic
  paralytic polio-   ÷   population in   X 100,000 = poliomyelitis per
  myelitis in study   region   100,000 school
  population in region   enterers in region

- Prevalence rate of   Prevalence rate of
  paralytic poliomyelitis   poliomyelitis per
  per 100,000 school   X   2   =   100,000 popula-
  enterers in region   tion in region

Prevalence in Region:

- Prevalence rate   Population   Prevalence of
  of poliomyelitis   ÷   100,000   X   in   =   poliomyelitis
  in region   region   in region

Prevalence in Country:

- Prevalence of   Prevalence of   Prevalence of
  poliomyelitis in   +   poliomyelitis   =   poliomyelitis
  one region   in all other   in country
                               regions

Prevalence Rate Per 100,000 Population in Country:

- Prevalence of   Population   Prevalence rate
  poliomyelitis   ÷   in   X 100,000 =   of poliomyelitis
  in country   country   in country

Exercise A

In this exercise you will estimate the prevalence and prevalence rate of paralytic poliomyelitis in the Coastal Region of Fictitia and in the country as a whole.

- Read and follow the instructions carefully.

- Write your answers in the spaces provided.

- When you need data, refer to page PO-13 in this booklet.

- If you have questions, consult with a Course Facilitator.

1. Have school enterers been surveyed for evidence of paralytic poliomyelitis in the Coastal Region of Fictitia?

   - If no, go to page PO-5, Incidence.

   - If yes, estimate the prevalence rate of the disease per 100,000 population in the Coastal Region in the following manner:

     a. Record the number of school enterers with paralytic poliomyelitis in the study population in the Coastal Region. _____ 180

     b. Record the number of school enterers in the study population in the Coastal Region. _____ 15,000

     c. Divide your answer to (a) by your answer to (b), then multiply times 100,000. (This figure is the prevalence rate of paralytic poliomyelitis per 100,000 school enterers in the Coastal Region.)

     $$\frac{180}{(a)} \div \frac{15000}{(b)} \times 100,000 = \underline{1200}$$

     d. Multiply your answer to (c) times 2. (This figure is the prevalence rate of poliomyelitis per 100,000 population in the Coastal Region.)

     $$\frac{1200}{(c)} \times 2 = \underline{2400}$$

2. To estimate the prevalence of poliomyelitis in the Coastal Region:

   a. Record the prevalence rate of poliomyelitis in the Coastal Region (from Step 1 d, above). _____ 2400

   b. Divide your answer to (a) by 100,000.

     $$\frac{2400}{(a)} \div 100,000 = \underline{0.024}$$

c. Record the total population in the Coastal Region.

10^7

d. Multiply your answer to (b) times your answer to (c).

$$\underbrace{0.2400}_{(b)} \times \underbrace{10^6}_{(c)} = 240000$$

3. To estimate the prevalence of poliomyelitis in Fictitia:

a. Record the prevalence of poliomyelitis in the Coastal Region (from Step 2 d, above).

240000

b. Record the prevalence of poliomyelitis in the Delta, Highland and Mountain Regions. (To save you time, this figure has been calculated for you using the same process described in Steps 1 and 2 for the Coastal Region.)

24,000

c. Add your answer to (a) and your answer to (b).

$$\underbrace{}_{(a)} + \underbrace{}_{(b)} = 264000$$

4. To estimate the prevalence rate of poliomyelitis per 100,000 population in Fictitia:

a. Record the prevalence of poliomyelitis in the country (from Step 3 c).

264000

b. Record the total population in the country.

16 M

c. Divide your answer to (a) by your answer to (b).

$$\underbrace{264000}_{(a)} \div \underbrace{16 M}_{(b)} = 0.264$$

d. Multiply your answer to (c) times 100,000.

$$\underbrace{0.26400}_{(c)} \times 100,000 = 26400$$

> When you have completed Exercise A, discuss your work with a Course Facilitator.

2.0 ESTIMATE THE ANNUAL INCIDENCE AND INCIDENCE RATE OF POLIOMYELITIS.

In the absence of an immunization programme, you can assume that the prevalence of poliomyelitis after age 3 remains constant. Furthermore, for the purpose of this exercise, you can assume that an equal number of new cases occurs in each of the first 3 years of life. Thus, the annual incidence rates of disease can be estimated using the prevalence rates calculated in the previous section.

The following process can be used to estimate the annual incidence and incidence rate of poliomyelitis.

Annual Incidence Rate Per 100,000 Population:

- Prevalence rate ÷ 3* = Annual incidence rate in children < 3 years of age

- Annual incidence rate in children < 3 years of age X Percentage of population < 3 years of age = Annual incidence rate of poliomyelitis per 100,000 population

Annual Incidence:

- Annual incidence rate of poliomyelitis ÷ 100,000 X Population = Annual incidence of poliomyelitis

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*NOTE: If national data for a country indicate that most of the new cases of poliomyelitis occur before age 4 or 5, you would divide the prevalence rate by 4 or 5, respectively.

Exercise B

In this exercise you will estimate the incidence and incidence rate of polio-myelitis in the Coastal Region of Fictitia.

- Read and follow the instructions carefully.
- Write your answers in the spaces provided.
- When you need data, refer to page PO-13 in this booklet.
- If you have questions, consult with a Course Facilitator.

1. To estimate the annual incidence rate of poliomyelitis per 100,000 population in the Coastal Region:

    a. Record the prevalence rate of poliomyelitis in the Coastal Region (from Exercise A, Step 1 d, page PO-3).   _2400_

    b. Divide your answer to (a) by 3. (This figure is the annual incidence rate of poliomyelitis per 100,000 children < 3 years of age in the region.)

    $$\frac{}{(a)} \div 3 \quad = \quad \underline{800}$$

    c. Record the percentage of the population < 3 years of age in the Coastal Region (expressed as a decimal).   _0·1_

    d. Multiply your answer to (b) times your answer to (c).

    $$\frac{0·1}{(b)} \times \frac{80}{(c)} = \underline{80,000}$$

2. To estimate the annual incidence of poliomyelitis in the Coastal Region:

    a. Record the annual incidence rate of poliomyelitis in the Coastal Region (from Step 1 d, above).   _80_

    b. Divide your answer to (a) by 100,000.

    $$\frac{80}{(a)} \div 100,000 \quad = \quad \underline{0.0008}$$

    c. Record the total population in the Coastal Region.   _10^7_

    d. Multiply your answer to (b) times your answer to (c).

    $$\frac{0·0008}{(b)} \times \frac{10^7}{(c)} = \underline{8000}$$

Exercise C

In this exercise you will compare the _estimated_ annual incidence of polio-
myelitis in each region of Fictitia with the _reported_ annual incidence in
each region.

- Read and follow the instructions carefully.
- Write your answers in the spaces provided.
- When you need data, refer to page PO-15.
- If you have questions, consult with a Course Facilitator.

1. Record on Table 1 on the next page the reported annual incidence of poliomye-
   litis in each region of Fictitia.

2. Record on Table 1 the estimated annual incidence of poliomyelitis in the
   Coastal Region of Fictitia (from Exercise B, Step 2 d, page PO-4). To
   save you time, the estimated annual incidence for the Delta, Highland,
   and Mountain Regions has already been calculated for you and recorded on
   the table. The figure shown was calculated using the same process described
   in Exercise B, Steps 1 and 2 for the Coastal Region.

3. Calculate "Reporting Completeness" by dividing the reported incidence
   for each region by the estimated incidence for that region, then multiply
   those figures times 100 to convert your answers to percentages. (Note:
   Since the estimated incidence for the Delta, Highland and Mountain Regions
   was calculated using a group rate, calculate "Reporting Completeness" for
   these three regions by first adding the reported incidence for each region.
   Then divide this sum by the estimated incidence for the three regions,
   and multiply your answer times 100 to convert it to a percentage.) Record
   your answers in the column titled "Reporting Completeness."

   The figures for reporting completeness reflect the percentage of actual
   cases of poliomyelitis reported in each region. For example, if reporting
   completeness for a region is 0.5%, this means that only 0.5% of actual cases
   of poliomyelitis in the region are reported.

4. Do some regions seem to have more reliable reporting systems than others? If yes, explain.

TABLE 1: REPORTING COMPLETENESS OF INCIDENCE

Region	Reported Incidence	Estimated Incidence	Reporting Completeness
Coastal	82.5	1001	10.3%
Delta	13		1.6%
Highland	45	798	5.1%
Mountain	7		0.8%

7.5%

When you have completed Exercise C, discuss your work on Exercises B and C with a Course Facilitator.

3.0 ESTIMATE THE AGE-SPECIFIC IMMUNITY TO EACH TYPE OF POLIOMYELITIS VIRUS.

Before initiating an immunization programme for poliomyelitis, it is important to identify the population at risk. This information can be obtained from a survey of residual paralysis (for example, of school enterers) that includes a question regarding the age of onset of the disease. (See WHO Manual, Book I, Annex 3b, for information on conducting such surveys.) Such information can also be obtained through serologic sampling for poliomyelitis antibodies against the three types of poliomyelitis virus. A serologic survey will identify the age groups that are highly susceptible to at least one type of virus as well as those that are naturally immune to all three types of virus. If such information is readily available, use it when planning an immunization schedule.

Exercise D

In this exercise you will estimate the age-specific immunity to each type of poliomyelitis virus in Fictitia in order to identify the population at risk in the country.

● Read and follow the instructions carefully.

● Write your answers in the spaces provided.

● When you need data, refer to page PO-15.

● If you have questions, consult with a Course Facilitator.

1. Have serosurveys of poliomyelitis infection been done in any region of Fictitia or in a similar region or country?

   ● If no, go to page PO-12.

   ● If yes, estimate the age-specific immunity to each type of poliomyelitis virus in the following manner:

      a. Record on Table 2, below, in the columns titled "% Immune" the percentage of children aged 5-8 months who were immune to each type of poliomyelitis virus.

      b. Repeat Step (a) for the other age groups.

      c. Subtract each percent recorded in the columns titled "% Immune" for the 5-8 months age group from 100%. Record your answers in the columns titled "% Susceptible."

      d. Repeat Step (c) for the other age groups.

TABLE 2:   IMMUNITY TO POLIOMYELITIS VIRUS

| Age | TYPE I | | TYPE II | | TYPE III | |
	% Immune	% Susceptible	% Immune	% Susceptible	% Immune	% Susceptible
5-8 mos.						
9-14 mos.						
15-35 mos.						
36-59 mos.						

PO-10

2. What is the largest percentage of children in each age group who are suscep-
    tible to <u>at least one</u> type of poliomyelitis virus?

        5-8 mos.   _95_ %
        9-14 mos.   _90_ %
        15-35 mos.   _50_ %
        36-59 mos.   _30_ %

3. Would there be any significant advantages in administering vaccine to children
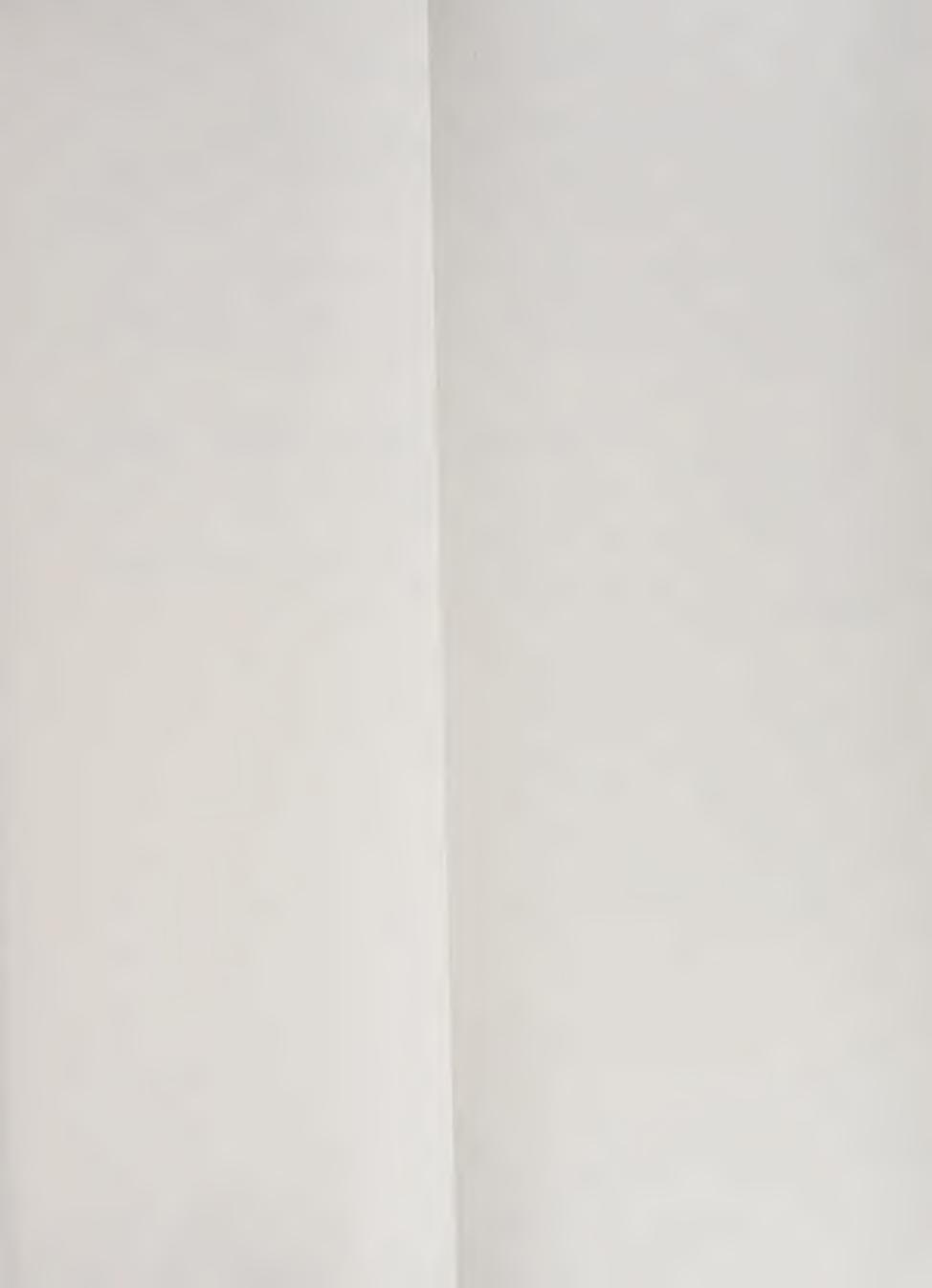   at 8 months of age rather than at 3 years of age? Why or why not?

CONCLUSION

This module has described procedures for estimating the prevalence and incidence of poliomyelitis, and the age-specific immunity to each type of poliomyelitis virus. These estimates can be used to plan an effective immunization programme. Once a programme is operating, the estimates can be used to evaluate that programme's success in preventing poliomyelitis.

The Annex to this booklet, which begins on page PO-17, contains extra copies of guidelines for estimating the prevalence and incidence of poliomyelitis, and for estimating the age-specific immunity to each type of poliomyelitis virus. These guidelines can be used to estimate the impact of the disease in your country.

> When you have completed this booklet on poliomyelitis, discuss your work on Exercise D with a Course Facilitator.

ANNEX:

EXTRA COPIES OF GUIDELINES FOR
ESTIMATING PREVALENCE AND
INCIDENCE OF POLIOMYELITIS, AND
AGE-SPECIFIC IMMUNITY TO
EACH TYPE OF POLIOMYELITIS VIRUS

NOTE: The guidelines in this Annex may be adapted for use in planning your
country's immunization programme.

GUIDELINES FOR ESTIMATING PREVALENCE
AND PREVALENCE RATE OF POLIOMYELITIS

1. Prevalence rate of poliomyelitis per 100,000 population in a region:

   Determine if school enterers have been surveyed for evidence of paralytic poliomyelitis in one or more regions of the country.

   - If no, consider how such surveys could be conducted in the future. For now, go to page PO-20, Incidence.

   - If yes, estimate the prevalence rate of the disease in each region for which data are available in the following manner.

     a. Record the number of school enterers with paralytic poliomyelitis in the study population in the region. _____

     b. Record the number of school enterers in the study population in the region. _____

     c. Divide your answer to (a) by your answer to (b), then multiply times 100,000. (This figure is the prevalence rate of paralytic poliomyelitis per 100,000 school enterers in the region.)

$$\frac{\quad\quad}{(a)} \div \frac{\quad\quad}{(b)} \quad X\ 100,000 \quad = \quad _____$$

     d. Multiply your answer to (c) times 2. (This is the prevalence rate of poliomyelitis per 100,000 population in the region.)

$$\frac{\quad\quad}{(c)} \quad X\ \ 2 \quad\quad = \quad _____$$

2. Prevalence of poliomyelitis in the region:

   a. Record the prevalence rate of poliomyelitis in the region (from Step 1 d). _____

   b. Divide your answer to (a) by 100,000.

$$\frac{\quad\quad}{(a)} \div 100,000 \quad = \quad _____$$

   c. Record the total population in the region. _____

   d. Multiply your answer to (b) times your answer to (c).

$$\frac{\quad\quad}{(b)} \quad X \quad \frac{\quad\quad}{(c)} \quad = \quad _____$$

3. Prevalence of poliomyelitis in a country:

   a. Add the prevalence of poliomyelitis in each region
      of the country.   _____

4. Prevalence rate of poliomyelitis per 100,000 population in the country:

   a. Record the prevalence of poliomyelitis in the
      country (from Step 3 a).   _____

   b. Record the total population in the country.   _____

   c. Divide your answer to (a) by your answer to (b).

$$\frac{}{(a)} \div \frac{}{(b)} = $$

   d. Multiply your answer to (c) times 100,000.

$$\frac{}{(c)} \times 100{,}000 = $$

GUIDELINES FOR ESTIMATING INCIDENCE

AND INCIDENCE RATE OF POLIOMYELITIS

1. Annual incidence rate of poliomyelitis per 100,000 population in a region:

    a. Record the prevalence rate of poliomyelitis in the region (from Step 1 d, page PO-18).   _____

    b. Divide your answer to (a) by 3. (This figure is the annual incidence rate of polio per 100,000 children < 3 years of age in the region.)

    $$\frac{\qquad}{(a)} \div 3 \quad = \quad \text{_____}$$

    c. Record the percentage of the population < 3 years of age in the region (expressed as a decimal).   _____

    d. Multiply your answer to (b) times your answer to (c).

    $$\frac{\qquad}{(b)} X \frac{\qquad}{(c)} \quad = \quad \text{_____}$$

2. Annual incidence of poliomyelitis in the region:

    a. Record the annual incidence rate of poliomyelitis in the region (from Step 1 d, above).   _____

    b. Divide your answer to (a) by 100,000.

    $$\frac{\qquad}{(a)} \div 100,000 \quad = \quad \text{_____}$$

    c. Record the total population in the region.   _____

    d. Multiply your answer to (b) times your answer to (c).

    $$\frac{\qquad}{(b)} X \frac{\qquad}{(c)} \quad = \quad \text{_____}$$

GUIDELINES FOR ESTIMATING THE AGE-SPECIFIC IMMUNITY
TO EACH TYPE OF PARALYTIC POLIOMYELITIS VIRUS

1. Determine if serosurveys of poliomyelitis infection have been done in any region of the country in which you are working or in a similar region or country.

   - If <u>no</u>, consider whether serosurveys could be done to provide data on immunity rates to each type of poliomyelitis virus in the future. (See WHO Manual, Book 1, Annex 36, for information on conducting such surveys.)

   - If <u>yes</u>,

     a. Record on the table, below, in the columns titled "% Immune" the percentage of children in the first age group who are immune to each type of poliomyelitis virus.

     b. Repeat Step (a) for the other age groups.

     c. Subtract each percent recorded in the columns titled "% Immune" for the first age group from 100%. Record your answers in the columns titled "% Susceptible."

     d. Repeat Step (c) for the other age groups.

IMMUNITY TO POLIOMYELITIS VIRUS

Age	TYPE I		TYPE II		TYPE III	
	% Immune	% Susceptible	% Immune	% Susceptible	% Immune	% Susceptible
5-8 mos.						
9-14 mos.						
15-35 mos.						
36-59 mos.						

2. What is the largest percentage of children in each age group who are susceptible to <u>at least one</u> type of poliomyelitis virus?

   5-8 mos. _____ %

   9-14 mos. _____ %

   15-35 mos. _____ %

   36-59 mos. _____ %